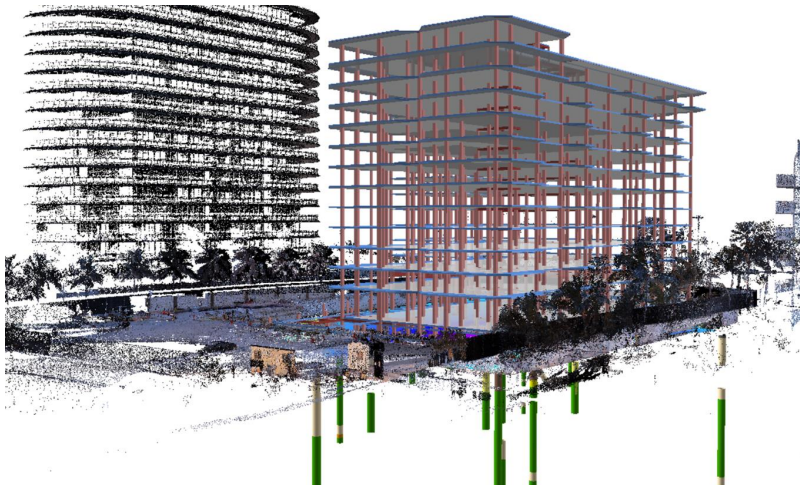


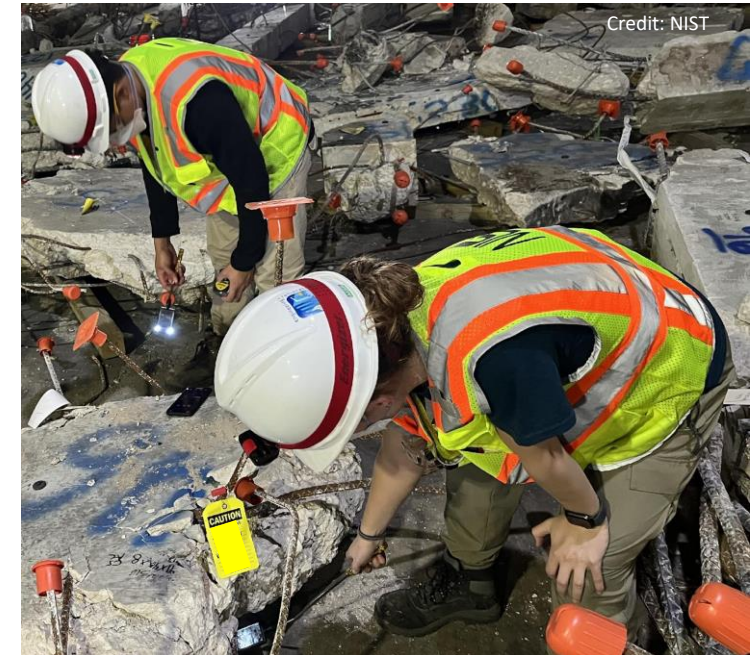
# NCST Investigation of the Champlain Towers South Collapse

## 3D Visualization of Evidence



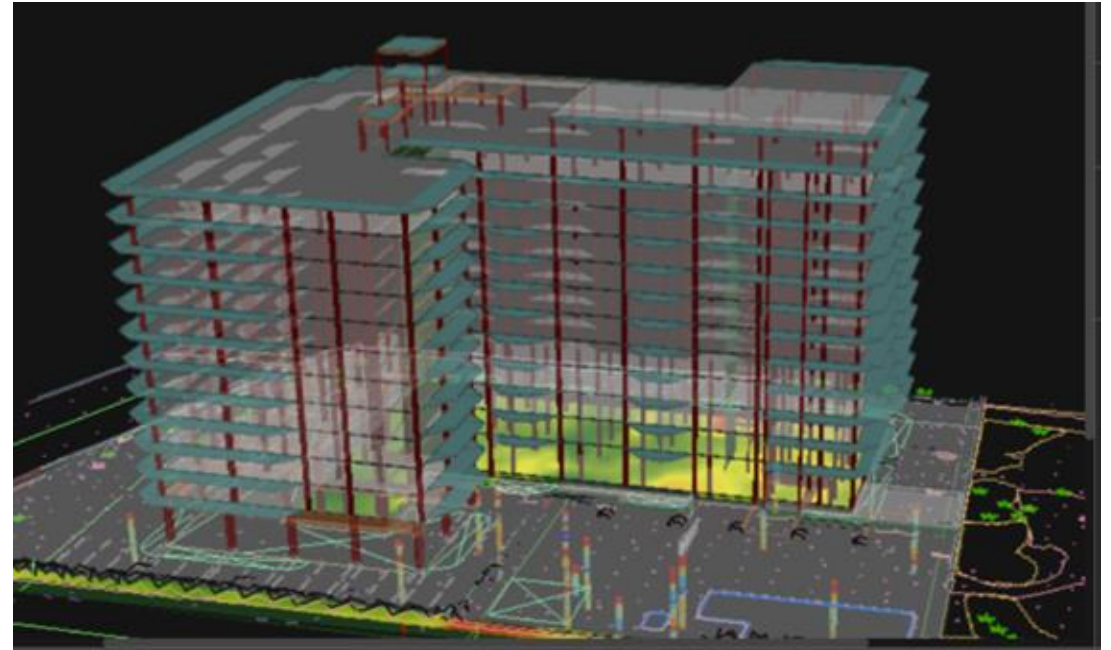
David G. Goodwin Jr., Ph.D.  
*Project Leader, Evidence Preservation  
Project*

Georgette Hlepas, Ph.D., PE  
*Project Leader, Remote Sensing &  
Visualization Project*



# Evidence Management & Visualization Goals

- Collect, document, and centrally manage physical evidence
- Identify original location of evidence specimens in building prior to collapse
- Depict evidence specimens in a geospatial model





# Physical Evidence Tagging

Physical evidence specimens were tagged with (1) paper tags and (2) wire lock tags

Physical evidence specimens were next tagged with (3) detailed paper tags and (4) radio-frequency induction (RFID) tags

NIST physical evidence database entries for specimens are securely accessed by reading RFID tags with a NIST mobile device.



Credit: NIST



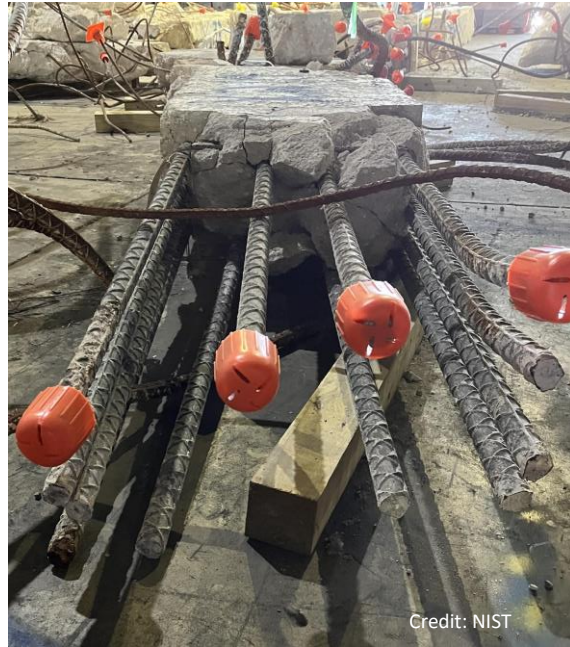
Credit: NIST



Credit: NIST

# Basic Structural Measurements and Documentation

Columns  
and Beams



Credit: NIST

Slabs and  
Walls



Credit: NIST

## Structural Measurements: [Sample: 450 DEMO](#)

### Column/Beam Overall Observations [↗](#)

Design Width	Design Depth	Sample height (column)/Sample length (beam)
<input type="text" value="13"/>	<input type="text" value="12"/>	<input type="text" value="120"/>
<input type="checkbox"/> Multi story	Number of stories	
	<input type="text" value="Number of stories"/>	

### Cross Sections [↗](#)

Bottom of column is denoted as "i" and top of column is denoted as "j". If column is multi-story, select "i.#" for bottom and "j.#" for top of columns in individual stories. Faces of columns are labeled 1-4 clockwise from the top face with respect to "i".

Cross Section 1	Cross Section 2	Cross Section 3	Cross Section 4
Cross-Section Location	Number of Bars	Number of Splice Bars	Number of Nominal Splice Bars
<input type="text" value="i.2"/>	<input type="text" value="4"/>	<input type="text" value="Number of Splice Bars"/>	<input type="text" value="Number of Nominal Splice Ba"/>

### Individual Longitudinal Reinforcing Bar Observations (1) [↗](#)

Start with top-left rebar and go clockwise labeling a-z.

Location	ASTM standard	Production mill	Steel type	Bar size
<input type="text" value="a"/>	<input type="text" value="ASTM A615"/>	<input type="text" value="8-"/>	<input type="text" value="S"/>	<input type="text" value="8.00000"/>
Grade mark	Inner dia.	Outer dia.	Notes	
<input type="text" value="60.00000"/>	<input type="text" value="0.93900"/>	<input type="text" value="1.15300"/>	<input type="text" value="Notes"/>	



# Identification Clues and Documentation

## Sample: 450 DEMO



### Identification Status

Probable location determined

### Identification Clues

☐ Beige exterior paint

Description

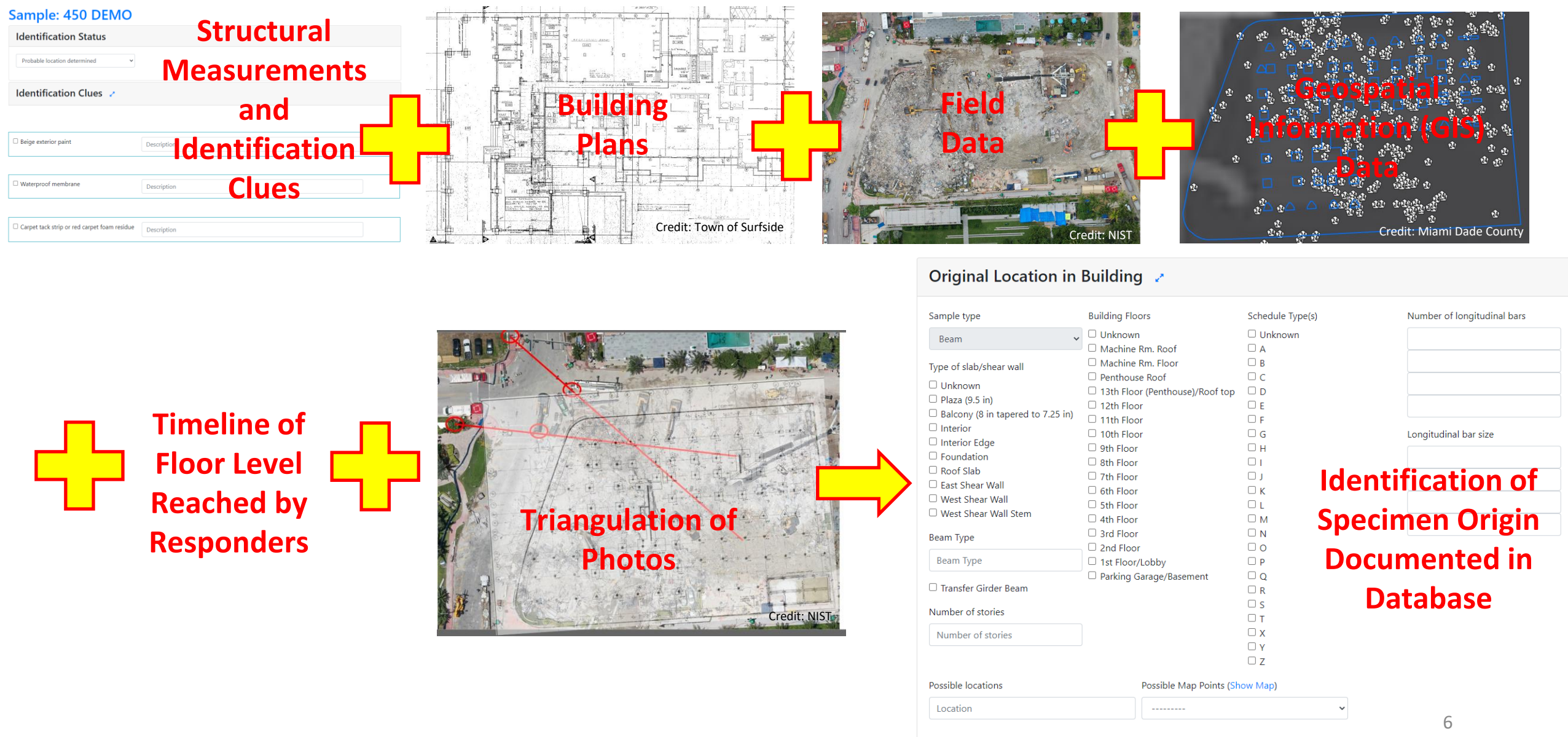
☐ Waterproof membrane

Description

☐ Carpet tack strip or red carpet foam residue

Description

# Combining Datasets to Determine Specimen Origin

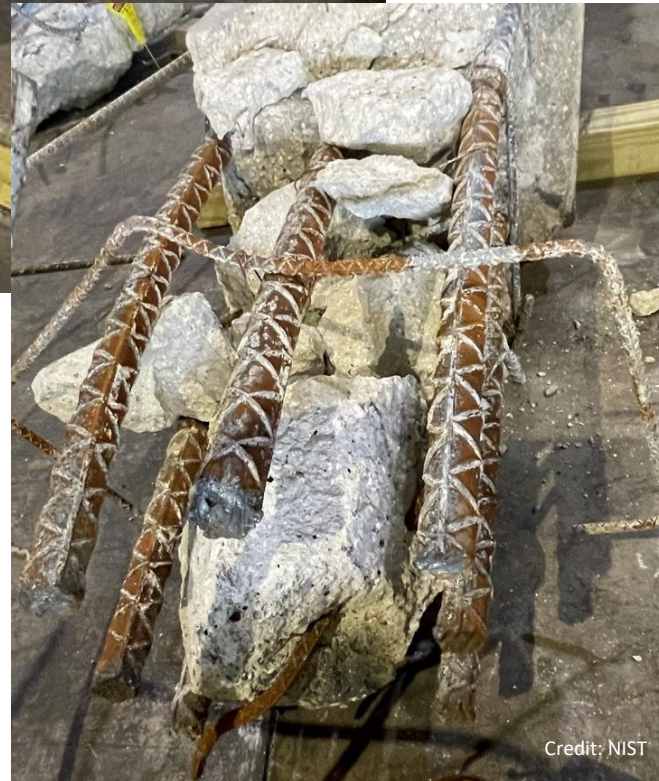




# Example Identification



Two-story column



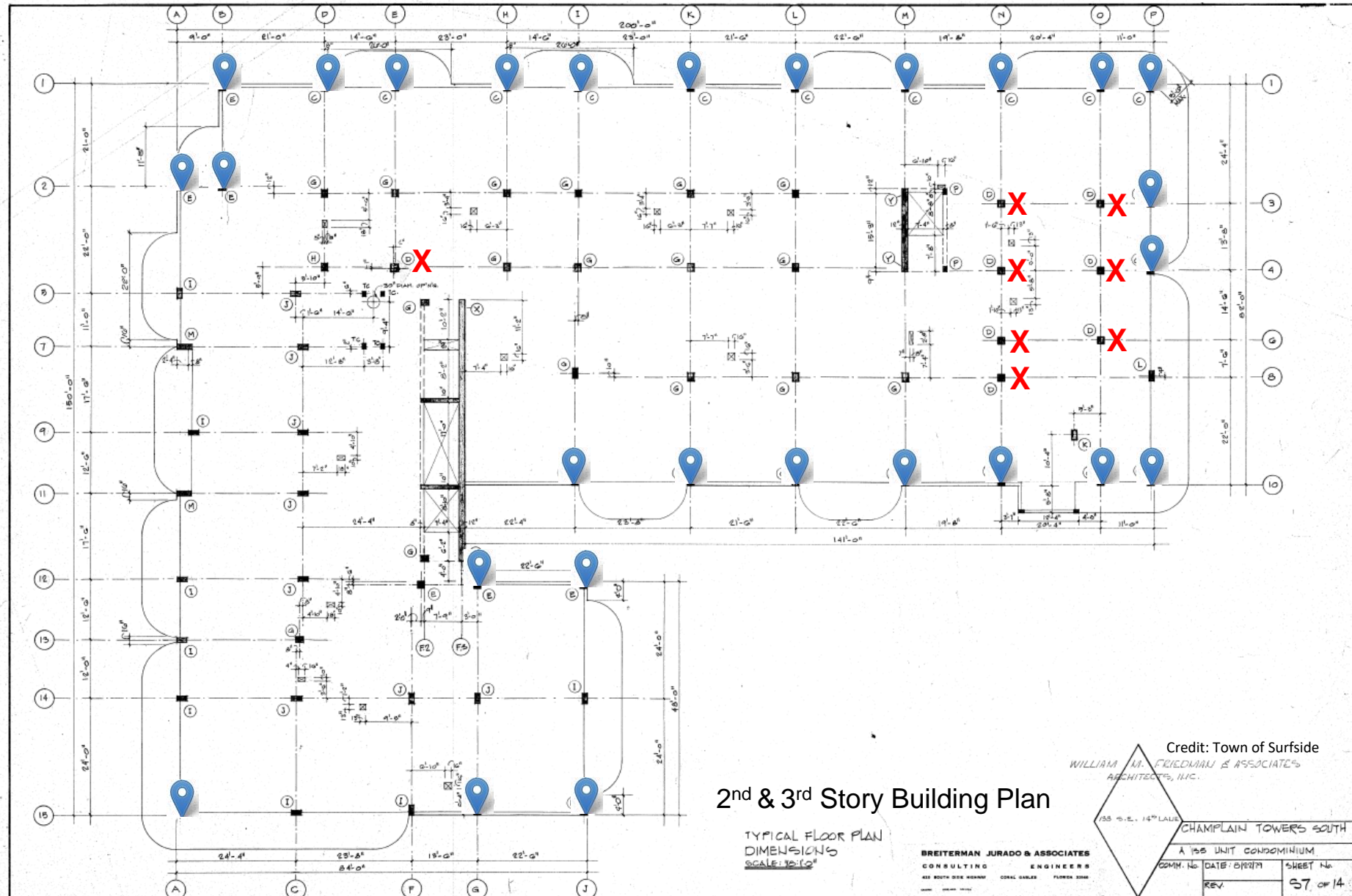
TYPE	(A)	(B)	(C)	(D)	(E)
SIZE	24" x 24"		16" x 16"	16" x 16"	16" x 16"
MACH. RM. ROOF	+139'-6"				
MACH. RM. FLOOR	+130'-10"				
ROOF	+124'-2"				
12th FLOOR (PENTHOUSE)	+119'-4"		4 #8	4 #8	4 #8
11th FLOOR	+108'-6"				
10th FLOOR	+97'-8"				
9th FLOOR	+88'-10"	III			
8th FLOOR	+78'-0"	I			
7th FLOOR	+71'-2"	III		4 #8	4 #8
6th FLOOR	+62'-4"	J	4 #8	6 #8	4 #9
5th FLOOR	+53'-0"	III	6 #8	8 #8	6 #9
4th FLOOR	+44'-8"	D	8 #8	8 #9	8 #9
3RD FLOOR	+35'-10"		8 #8	8 #9	8 #9
2ND FLOOR	+27'-0"		8 #9	8 #10	8 #10
LOBBY FL.	+13'-4"	12 #10 4 E.F.	8 #10	8 #11	
BASAMENT FL.	+0'-2"	12 #10 4 E.F.	8 #11 3 E.F.	12 #11 4 E.F.	
				COL. E-4 UP TO EL. +105'-6"	

Credit: Town of Surfside



# Example Identification

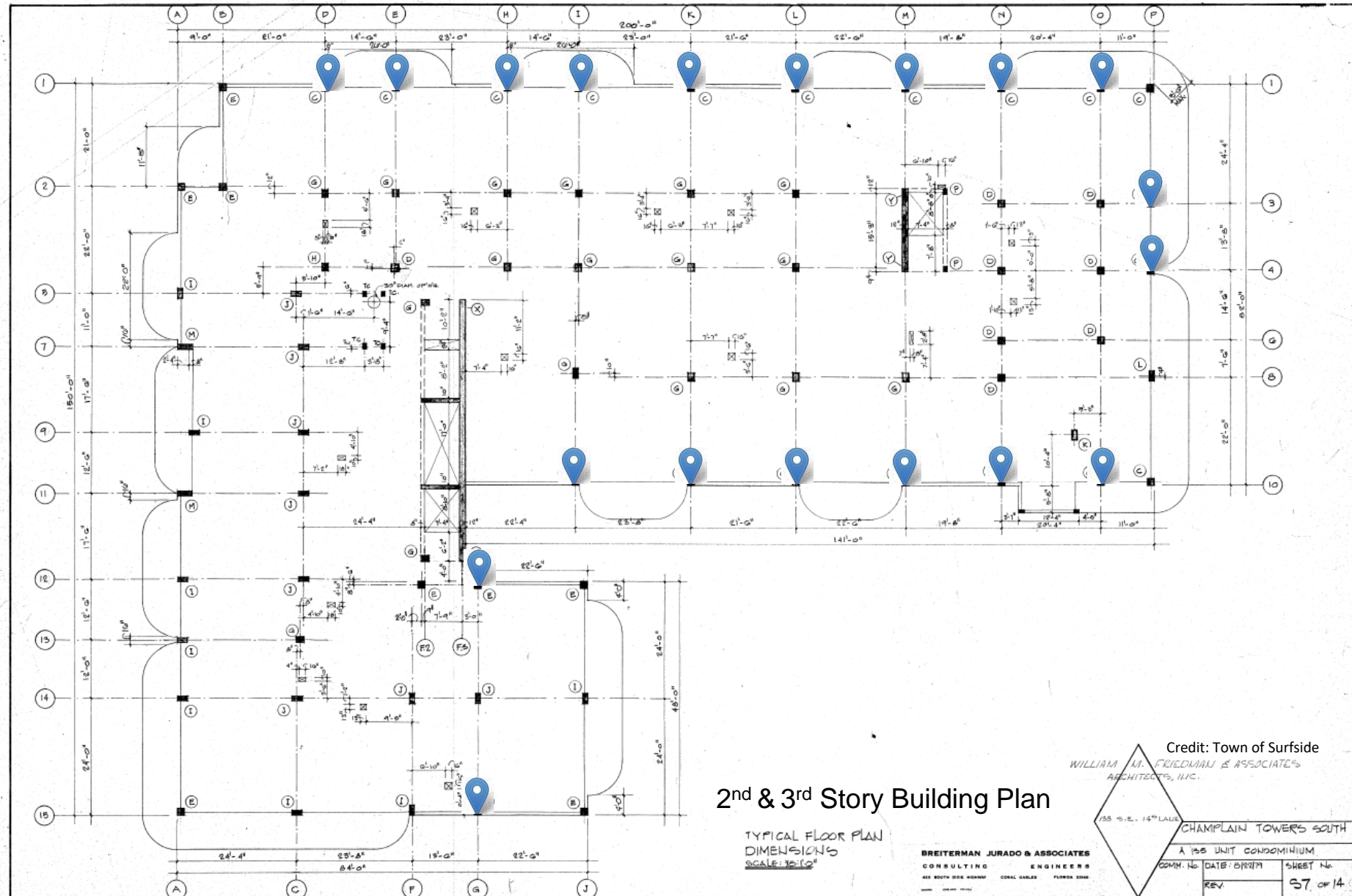
Blue = Location Possible





# Example Identification


Blue = Location Possible

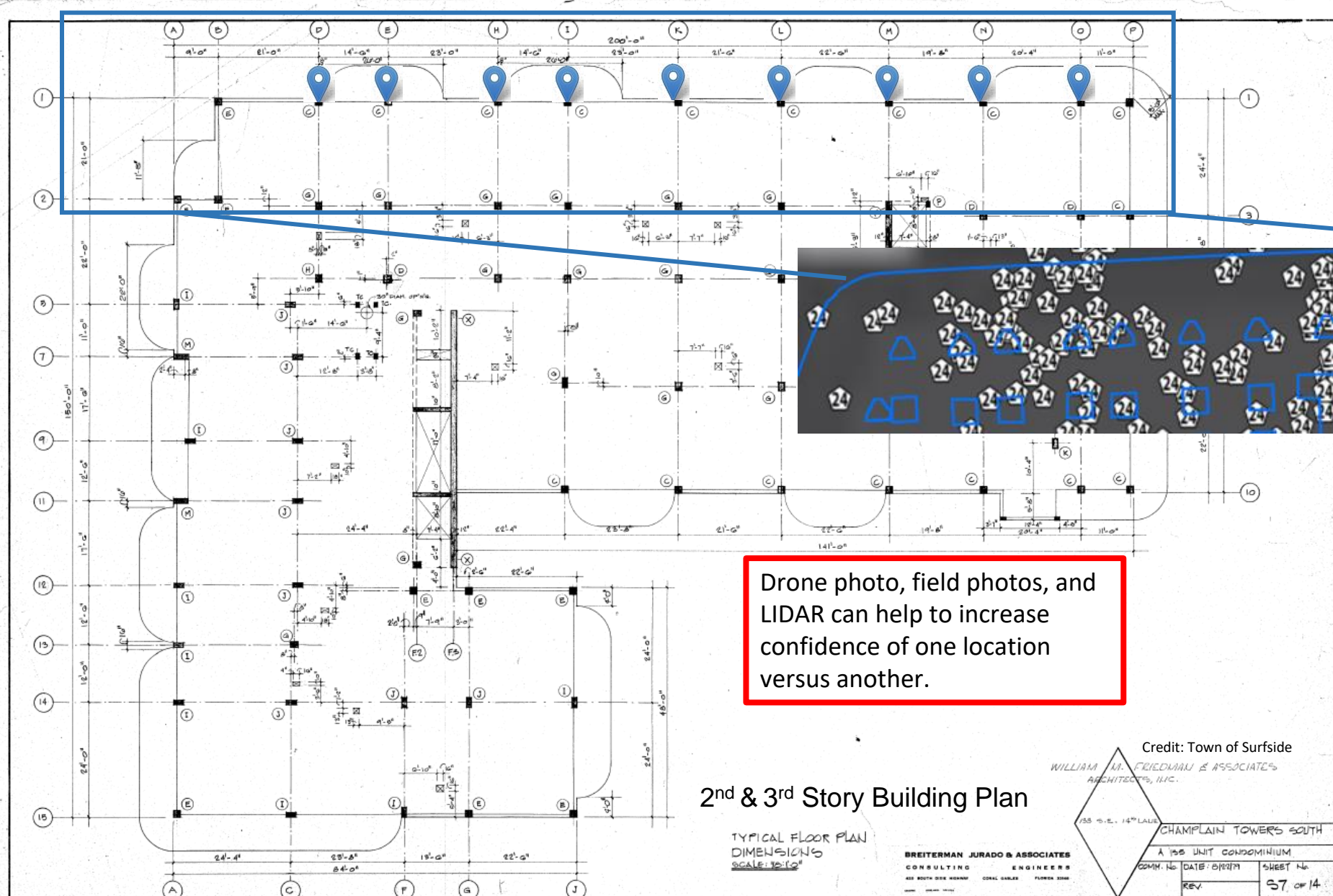


# Example Identification

Blue = Location Possible

**Geospatial  
Information  
System (GIS) Data**

 = GIS point



Drone photo, field photos, and  
LIDAR can help to increase  
confidence of one location  
versus another.





# 3D Geospatial Model

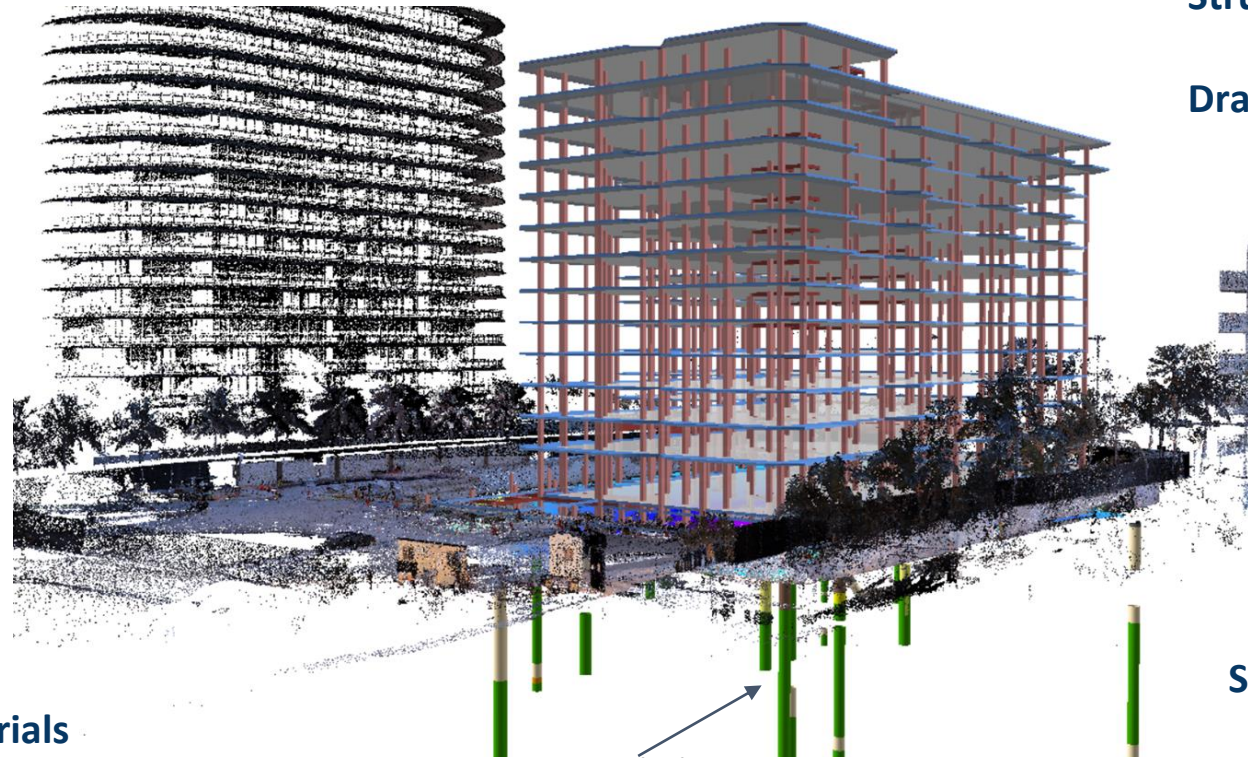
## Why a 3D Model?

Data Compilation, Access, Visualization, Communication

**Remote Sensing Data**  
Aerial Images  
Surface Measurements  
Photos & Videos

**Site History Data**  
Historical Images  
Building Records

**Evidence**  
Building Materials  
Interviews/Focus Groups  
Audio recordings (911 calls)



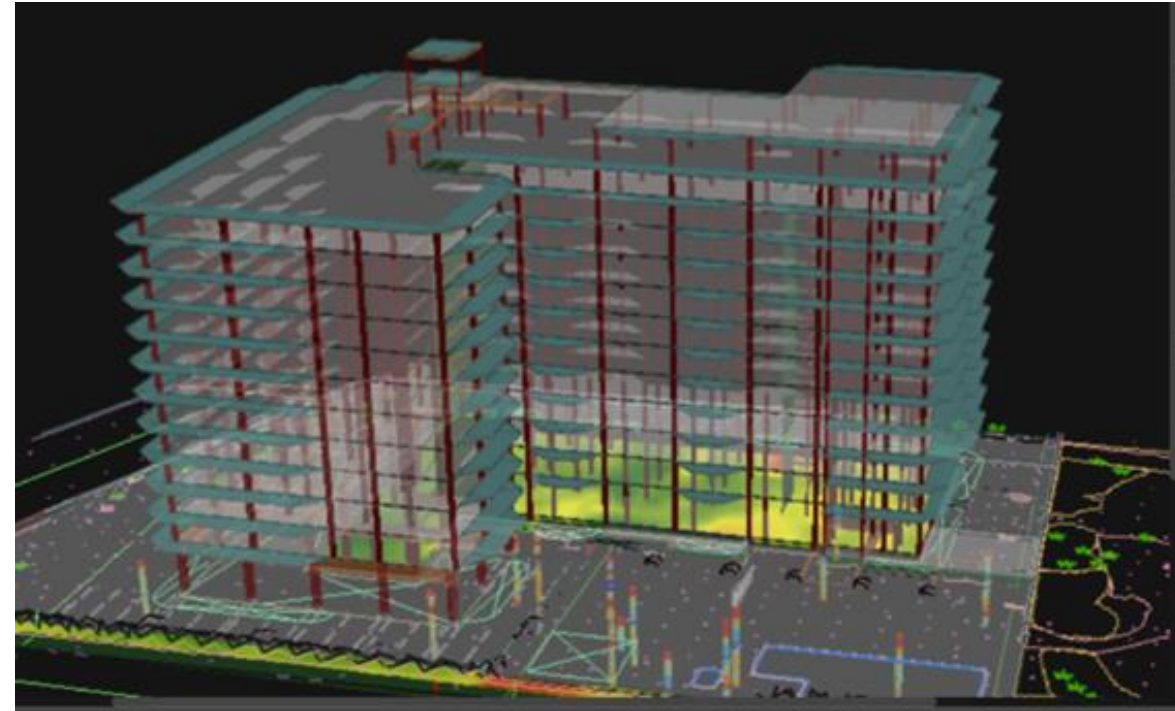
**Structural Elements**  
Plans/Design  
Drawings  
Inspection reports

**Material Testing**  
Non-Destructive  
Destructive

**Subsurface**  
Soil and Rock  
Utilities  
Groundwater

# Evidence Visualization Model

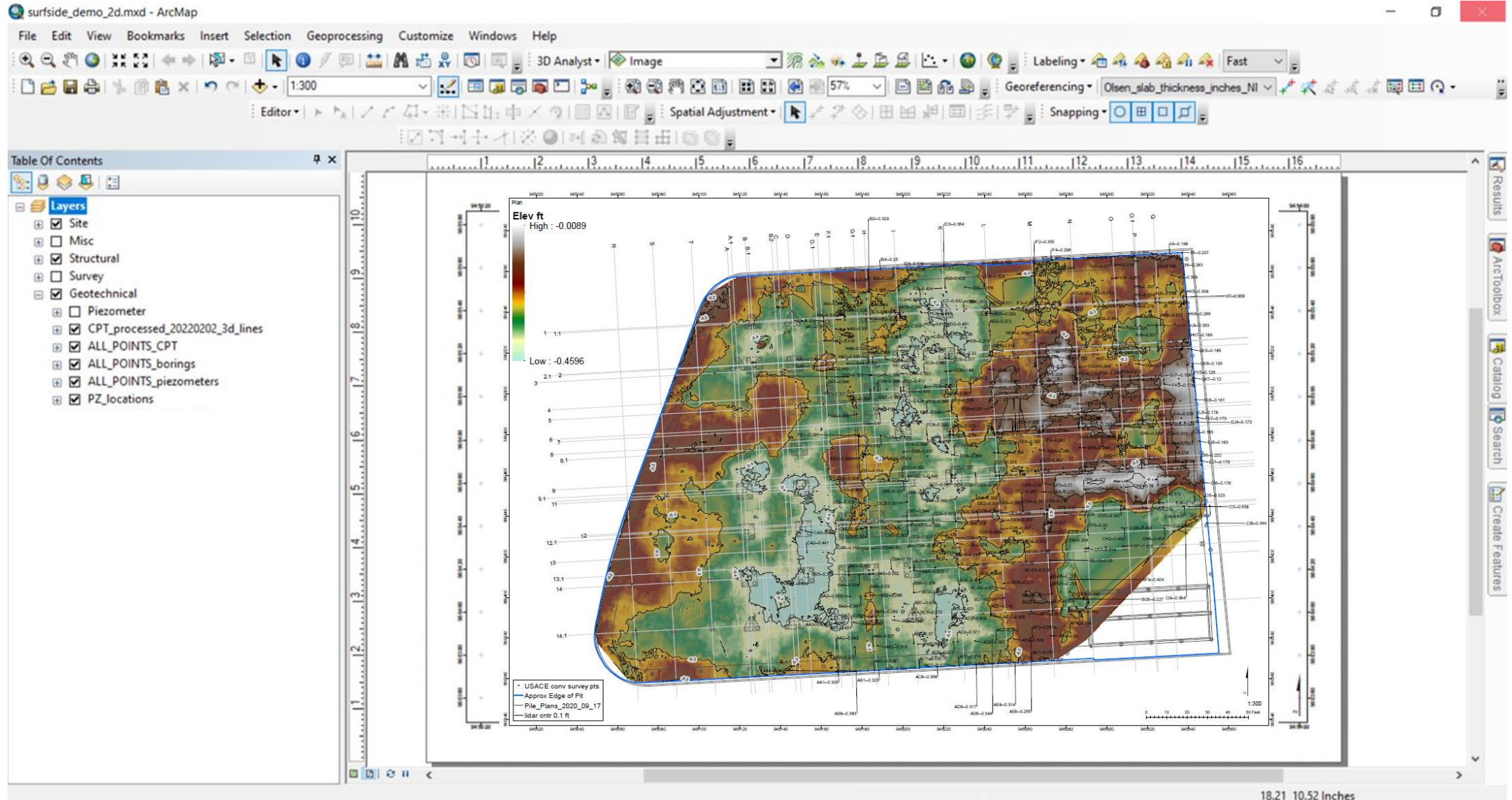
- Base model developed based on Plan Drawings
- Additional data added to the model as it is obtained
- Data grouped in layers that can be turned on/off
- Features can be selected to see additional data





# Preview Model Animation

# 2D Map & Section Views w/Layers and Attributes





# Current Status of Visualization Efforts

Current Model Includes

- Structural Elements

- Subsurface Investigation Data

- Survey and Remote Sensing Data

- Historical Aerials and Maps

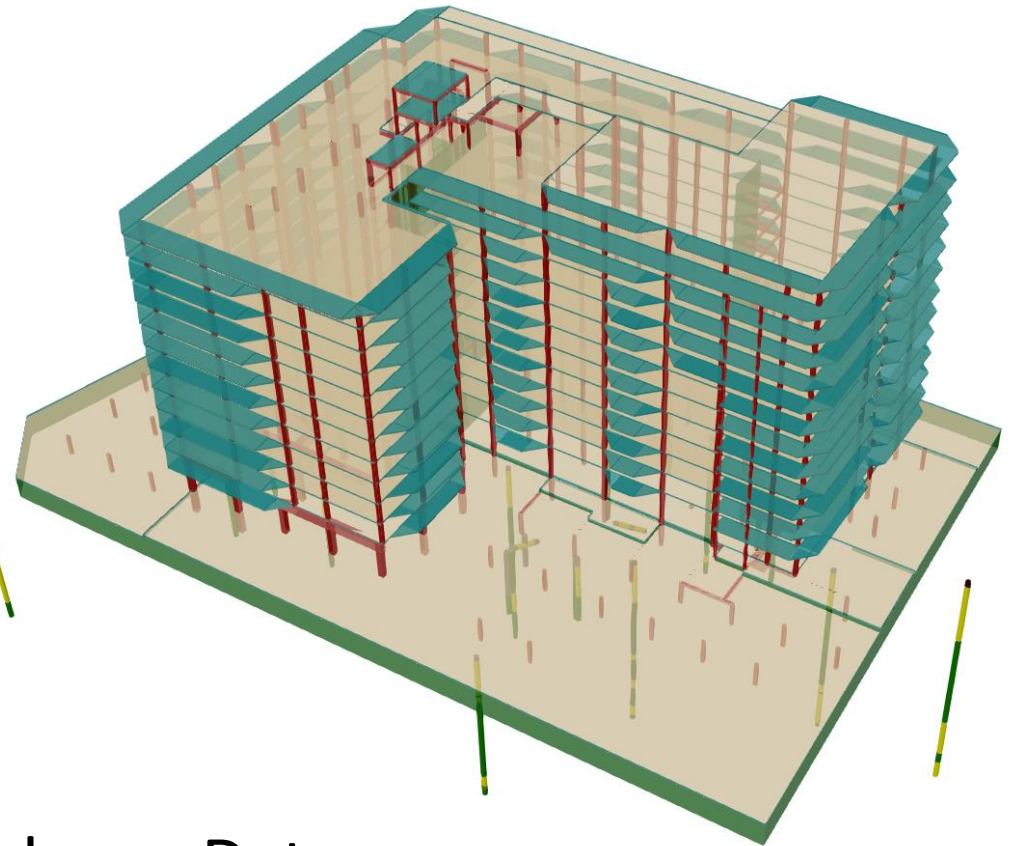
Work-in Progress

- Adding additional data

  - Material Test Results & Evidence Data

  - Add Additional Photos, Imagery, and Recordings

- Modifying Team Data Accessibility



# Future Work - Video Animations of Failure Scenarios

## Visualization of Failure Scenarios

Clear and concise presentation

Communication tool

## Current Status

Scope of Work Development

Coordination with All Teams

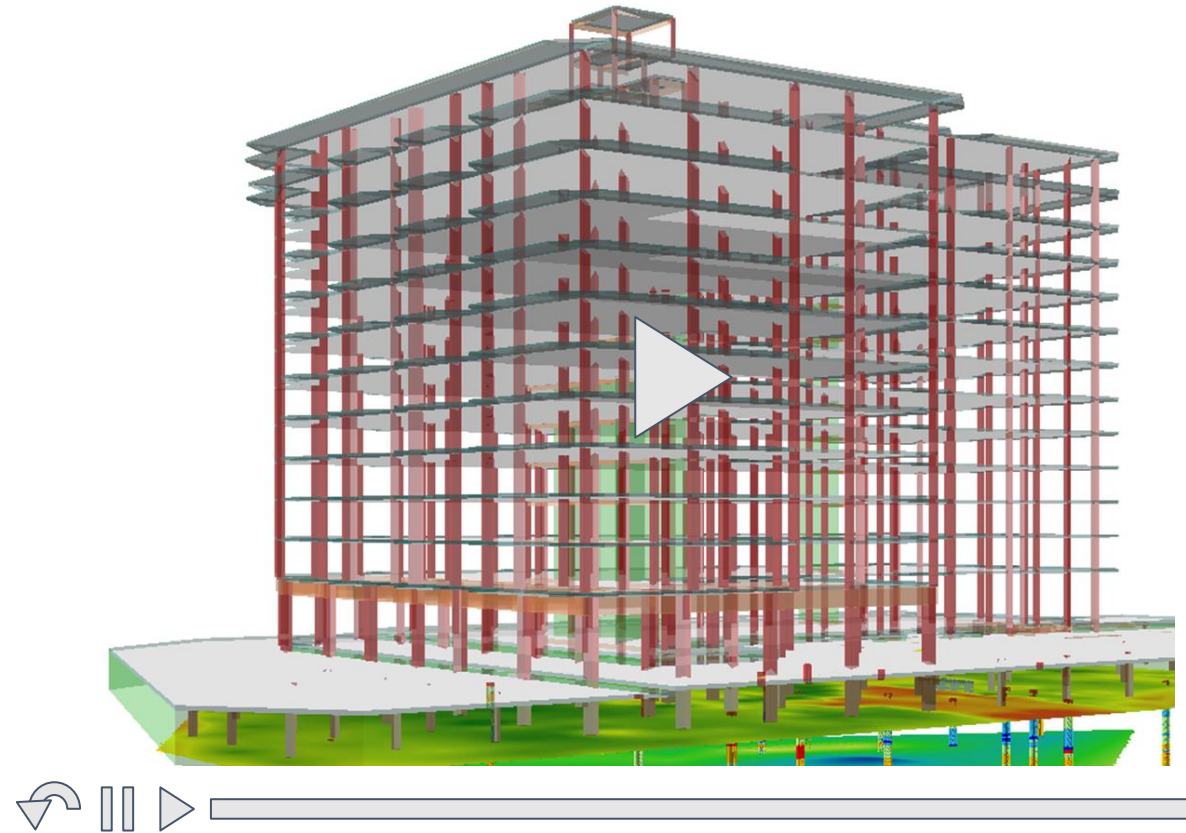


Illustration of Animation Concept



# **NCST Investigation of the Champlain Towers South Collapse**

## **3D Visualization of Evidence**

**Presenters:** David G. Goodwin, Jr.  
Georgette Hlepas